END POSITION DETECTION METHOD AND APPARATUS FOR MATERIAL TO BE CARRIED

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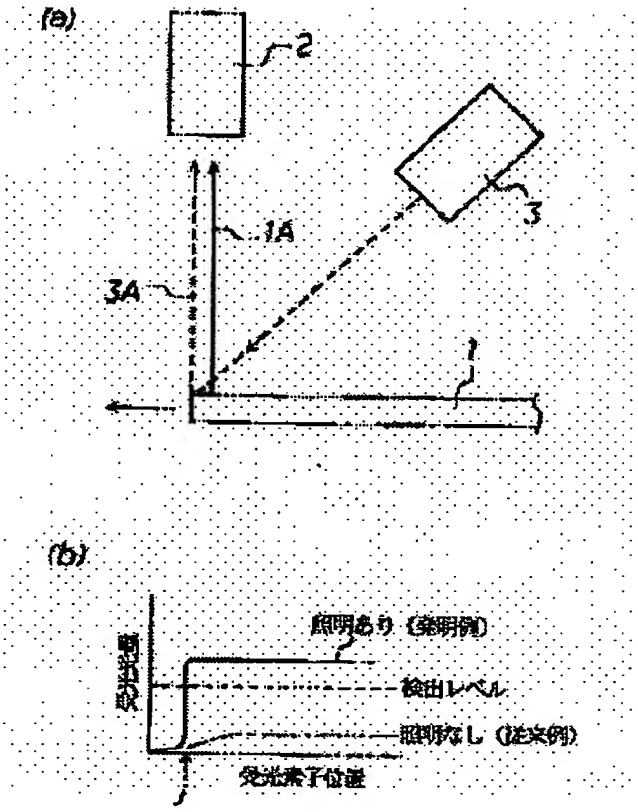
Abstract of **JP2002286419**

PROBLEM TO BE SOLVED: To provide an end position detection apparatus that can accurately detect an end position even if the change in the end temperature is large, at the same time, can be maintained easily, and has less restrictions in the installation location. SOLUTION: In the end detection method of a material to be carried, a self-luminance from the end of a material to be carried is received by the image sensor of a camera that is arranged at the upper section of a transport line, and the position of the end is detected based on the quantity of received light of the self-luminance thus obtained. When the quantity of received light of self-luminance that is received by the image sensor is in shortage, light from a light source that is arranged at the upper section is applied to the end, reflection light obtained by reflection from the end is received by an image sensor in addition to the self-luminance and the quantity of received light of the reflection light obtained by reception is added to the quantity of received light of the self-luminance to detect the position of the end.



PATENT ABSTRACTS OF JAPAN

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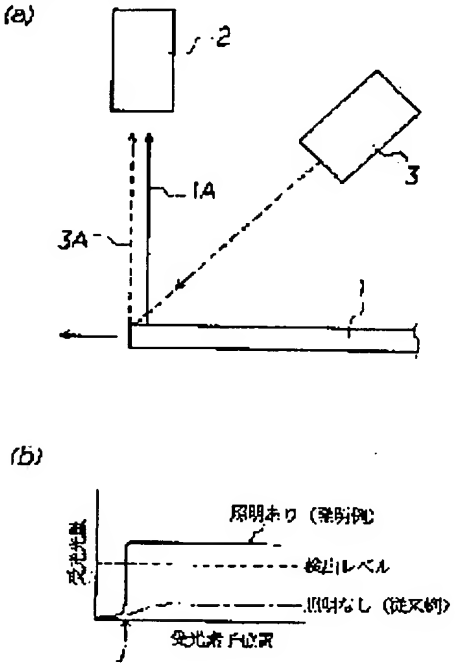
KATAYAMA JIRO

(54) END POSITION DETECTION METHOD AND APPARATUS FOR MATERIAL TO BE CARRIED

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an end position detection apparatus that can accurately detect an end position even if the change in the end temperature is large, at the same time, can be maintained easily, and has less restrictions in the installation location.
SOLUTION: In the end detection method of a material to be carried, a self-luminance from the end of a material to be carried is received by the image sensor of a camera that is arranged at the upper section of a transport line, and the position of the end is detected based on the quantity of received light of the self-luminance thus obtained. When the quantity of received light of self-luminance that is received by the image sensor is in shortage, light from a light source that is arranged at the upper section is applied to the end, reflection light obtained by reflection from the end is received by an image sensor in addition to the self-luminance and the quantity of received light of the reflection light obtained by reception is added to the quantity of received light of the self-luminance to detect the position of the end.



LEGAL STATUS

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[Date of extinction of right]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] In the edge location detection approach of a conveyed ingredient of detecting the location of said edge based on the light-receiving quantity of light of said spontaneous light which receives the spontaneous light from the edge of a conveyed ingredient with the image sensors of the camera arranged above conveyance Rhine, and is received and obtained When the light-receiving quantity of light of the spontaneous light which receives light with said image sensors runs short Light is irradiated at said edge from the light source arranged above said conveyance Rhine. The edge location detection approach of the conveyed ingredient characterized by adding the reflected light obtained by reflecting in said edge to said spontaneous light, applying to the light-receiving quantity of light of said spontaneous light the light-receiving quantity of light of said reflected light which receives light, and is received and obtained with said image sensors, and detecting the location of said edge.
[Claim 2] The edge location detection approach of the conveyed ingredient according to claim 1 characterized by setting up the luminous intensity which measures the temperature of said edge and irradiates it from said light source based on the temperature acquired before detecting the location of said edge.
[Claim 3] The edge location detection approach of the conveyed ingredient according to claim 1 or 2 characterized by adjusting the luminous intensity which irradiates light from said light source based on the sum of the light-receiving quantity of light of said reflected light which irradiates, and is received and obtained, and the light-receiving quantity of light of said spontaneous light to said edge from the upper light source.
[Claim 4] The dimension measuring method of the conveyed ingredient characterized by measuring the die length of said conveyed ingredient, or the width of face of said conveyed ingredient based on the location of said edge detected using the edge location detection approach of a conveyed ingredient according to claim 1 to 3.
[Claim 5] Edge location detection equipment of the conveyed ingredient characterized by constituting and becoming so that it may have the camera which has the image sensors arranged above conveyance Rhine, and the light source arranged above said conveyance Rhine so that light can be irradiated in the visual field of this camera and the edge location of a conveyed ingredient may be detected based on the light-receiving quantity of light of said image sensors.
[Claim 6] Measurements-of-length equipment of the conveyed ingredient characterized by coming to constitute as point location detection equipment which arranges the edge location detection equipment of a conveyed ingredient according to claim 5 from back end section location detection equipment to the downstream of conveyance Rhine, and detects the location of the point of said conveyed ingredient.
[Claim 7] The width-of-face measuring device of the conveyed ingredient characterized by coming to constitute as width-of-face edge location detection equipment which arranges the edge location detection equipment of a conveyed ingredient according to claim 5 on both sides across conveyance Rhine, and detects the location of the width-of-face edge of said conveyed ingredient.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a measuring device at the measuring method list which used the equipment and it for the edge location detection approach list of a suitable conveyed ingredient to detect the edge location of a conveyed ingredient and the ingredient between heat conveyed especially.
[0002]
[Description of the Prior Art] Conveying ingredients, such as a strip and tubing, it is important to measure a dimension with a sufficient precision, when manufacturing the ingredient, for example, width of face and die length are measured, and the hot-rolling strip conveyed rolls out and is manufactured. forming a CCD camera (the camera which has image sensors hereafter -- or it only being called a camera) above a conveyance table, establishing the light source under a camera and the conveyance table which counters as an approach of measuring the width of face and die length of a conveyed ingredient, and performing location detection of the ingredient between heat is known.
[0003] When doing in this way and performing location detection of the ingredient between heat, however, the light source which the conveyance table established caudad With the scale with which the lens dispersed from the ingredient between heat, to a dirt and cone sake It must maintain by high frequency and there is a fault that a maintenance is serious. Moreover, when it is going to install equipment, it may be unable to install by constraint of the light of the downward light source being shaded by the conveyance table near the rolling mill with much miscellaneous equipment.
[0004] As an approach of canceling such a trouble, the spontaneous light from a conveyed ingredient is received with image sensors, and the method of detecting the edge location of a conveyed ingredient is learned widely. For example, having applied the above-mentioned approach is shown in the measurements-of-length equipment shown in drawing 5 at JP,55-12478,A. In drawing 5 , 1 is a conveyed ingredient, it is conveyed in the direction shown by the drawing Nakaya mark, 2' is a camera which has predetermined angle-of-visibility I, and 14a, 14b, and 14c are photoelectric switches which have spot-like minute visual field RO, Ha, and NI, respectively.
[0005] Here, camera 2' is edge location detection equipment constituted so that a point location might be detected, and camera 2' has image-sensors 2a and image formation system 2b of 1-dimensional one, as shown in drawing 6 . On the other hand, with this measurements-of-length equipment, they are photoelectric switch 14a, 14b, and 14c. It consists of two or more pairs of projectors, and an electric eye, and the back end location detection equipment which detects optically the difference in the condition of being in the condition that there is no conveyed ingredient 1 in a visual field, and a visual field, and detects the back end location of the conveyed ingredient 1 is constituted. And photoelectric switch 14a, 14b, and 14c And the signal of camera 2' is inputted into the data-processing means 15.
[0006] if the measurement principle of the die length in this equipment is explained, the conveyed ingredient 1 will convey with this measurements-of-length equipment -- having -- the back end -- one photoelectric switch 14a of back end location detection equipment, 14b, and 14c When detected, a tip measures the die length of the conveyed ingredient 1 in the condition of entering in the visual field of camera 2'. That is, in the condition of drawing 5 (c), a photoelectric switch is 14b. Although it is the moment of detecting the back end location of the conveyed ingredient 1 Since the tip is not contained in the visual field of camera 2', the die length of the conveyed ingredient 1 cannot be measured. Since the tip is not contained in the visual field of camera 2' in the state of drawing 5 (b), similarly it cannot measure, but it will be in the condition of drawing 5 (a), and for the first time, the moment photoelectric switch 14a detected the back end, a tip enters in the visual field of camera 2', and is in the condition that the die length of the conveyed ingredient 1 can be

measured.
[0007] In this condition, die-length X of the conveyed ingredient 1 is expressed with a formula (1).
X=L1+deltaL+n-L2 ..... (1)
L1 [in addition,] Photoelectric switch 14a from -- the distance to the criteria location (starting point) of camera 2', and L2 or it is the distance between photoelectric switches and, as for n, which photoelectrical sensor detected the back end location of the object ingredient 1 (drawing 5 photoelectric switch 14a) -- being shown -- 14a, 14b, and 14c a case -- respectively -- 0, 1, and 2 -- becoming .
[0008] moreover -- delta -- L -- a camera -- two -- ' -- criteria -- a location -- from -- -ed -- conveyance -- an ingredient -- one -- a tip -- up to -- distance -- it is -- a tip -- a location -- detection -- equipment -- ****** -- constituting -- having had -- a camera -- two -- ' -- detecting . die-length deltaS (photo detector No.1 - No.J) of the image sensors which are receiving the spontaneous light from the edge of the conveyed ingredient 1 in camera 2' which is tip location detection equipment as shown in drawing 6 -- Hata of the conveyed ingredient 1 -- the manager -- it is constituted so that it may correspond with deltaL.
[0009] several [then, / of the photo detector from which the light-receiving quantity of light of the spontaneous light from an edge has become more than a disregard level in camera 2' which is tip location detection equipment] -- detecting J -- several -- J is made into the edge location detection value of the conveyed ingredient 1, it asks for deltaL by the formula (2), and the edge location of the conveyed ingredient 1 is detected. In addition, deltaL is also the edge die length of the conveyed ingredient 1.
deltaL=300 / 1024, and j ..... (2)
However, the light-receiving element number of image-sensors 2a is made into 1024 pieces, and the visual field of camera 2' is 300mm. It carried out.
[0010] Since it consists of this measurements-of-length equipment so that edge location deltaL of the detected conveyed ingredient 1 may be sent to the data-processing means 15 and may calculate X by the formula (1) with the data-processing means 15, die-length X of the conveyed ingredient 1 can be measured.
[0011]
[Problem(s) to be Solved by the Invention] However, there was a trouble that the width of face and die length which were measured in Rhine which hot-rolls a steel plate may differ from an actual measurement using the camera which has the image sensors constituted so that an edge location could be detected like the above. Then, in order to study the above-mentioned cause, this invention persons constituted the camera 2 which has image sensors so that an edge location could be detected like the above, as they showed the spontaneous light from the point of a steel plate to drawing 7 , they received light by image-sensors 2a, and investigated the relation between the photo detector location of image-sensors 2a, and the light-receiving quantity of light from an edge. consequently , although it changed a lot , and the spontaneous light reinforcement from an edge needed an edge close in the visual field of a camera 2 when the temperature of an edge be low in order that the cause by which the measured die length differ from an actual measurement might change the temperature of an edge a lot with an ingredient , it became clear that the light-receiving quantity of light of all photo detectors may become under a disregard level , and location detection may be able to be omit .
[0012] in addition, the camera 2 shown in drawing 7 -- the light-receiving wavelength of a photo detector -- 0.8 mum it is -- the 1-dimensional image sensors whose light-receiving element number is 1024 pieces -- having -- and a visual field -- a conveyance Rhine top -- 300mm it is -- the thing was used. If an example of the above-mentioned result is explained, will constitute so that an edge location can be detected and the drawing conditions of a camera 2 will be doubled with an elevated temperature. When the temperature of an edge is low and spontaneous light reinforcement becomes 1/1000 when the light-receiving time amount of image sensors is set as 1ms for example Although the edge is contained in the visual field of a camera 2 as shown in drawing 8 (a), the light income of all photo detectors becomes under a disregard level, and the edge location cannot be detected.
[0013] By the way, in having set the light-receiving time amount of image sensors as 1 second and a long time, when the temperature of an edge was low where diaphragm conditions are doubled with an elevated temperature, detection spacing becomes long, the ingredient movement magnitude in the meantime is large, and since it generates also when it not only cannot perform highly precise location detection, but detection of an edge cannot be performed, such an approach is not employable, in order to avoid this.
[0014] moreover, when the drawing conditions of a camera 2 are doubled with low temperature and the light-receiving time amount of image sensors is set as 1ms contrary to the above-mentioned detection conditions Since a highly precise edge location cannot be detected unlike the location detection value j when the light-receiving quantity of light of a photo detector is proper (refer to drawing 8 (c)) as the light-

receiving quantity of light of a photo detector becomes excessive and it is shown in drawing 8 (b) when edge temperature is high, this approach is not employable, either.
[0015] Then, it is for constraint of an installation to offer little edge location detection equipment and its approach easily [a maintenance] while the purpose of this invention is to cancel the trouble in the edge location detection approach of the conveyed ingredient of the above-mentioned conventional technique, and it can detect an edge location with high precision, even when change of edge temperature is large.
[0016]
[Means for Solving the Problem] This invention receives the spontaneous light from the edge of a conveyed ingredient with the image sensors of the camera arranged above conveyance Rhine. In the edge location detection approach of a conveyed ingredient of detecting the location of said edge based on the light-receiving quantity of light of said spontaneous light received and obtained When the light-receiving quantity of light of the spontaneous light which receives light with said image sensors runs short Light is irradiated at said edge from the light source arranged above said conveyance Rhine. It is the edge location detection approach of the conveyed ingredient characterized by adding the reflected light obtained by reflecting in said edge to said spontaneous light, applying to the light-receiving quantity of light of said spontaneous light the light-receiving quantity of light of said reflected light which receives light, and is received and obtained with said image sensors, and detecting the location of said edge.
[0017] Thus, by constituting, even when edge temperature is low, highly precise location detection can be performed now and the above-mentioned technical problem can be solved. or [moreover, / that this invention sets up the luminous intensity which measures the temperature of said edge and irradiates it from said light source in the above based on the temperature acquired before detecting the location of said edge] -- or Adjusting the luminous intensity which irradiates light from said light source based on the sum of the light-receiving quantity of light of said reflected light which irradiates, and is received and obtained, and the light-receiving quantity of light of said spontaneous light to said edge from the upper light source Since highly precise location detection can be performed, it is desirable, and since using both together can perform highly precise location detection, it is still more desirable.
[0018] This invention can also be made into the dimension measuring method of the conveyed ingredient characterized by measuring the die length of said conveyed ingredient, or the width of face of said conveyed ingredient further again based on the location of said edge detected by above either using the edge location detection approach of the conveyed ingredient a publication. This invention which uses for the above-mentioned approach is edge location detection equipment of the convey ingredient characterize by to constitute and become so that it may have the camera which has the image sensors arrange above conveyance Rhine , and the light source arrange above said conveyance Rhine so that light may be irradiate in the visual field of this camera and the edge location of a convey ingredient may be detect based on the light-receiving quantity of light of said image sensors .
[0019] Moreover, this invention can arrange the edge location detection equipment of the above-mentioned conveyed ingredient from back end section location detection equipment to the downstream of conveyance Rhine, and can also use it as the measurements-of-length equipment of the conveyed ingredient characterized by coming to constitute as point location detection equipment which detects the location of the point of said conveyed ingredient. Or this invention can arrange the edge location detection equipment of the above-mentioned conveyed ingredient on both sides across conveyance Rhine, and can also use it as the width-of-face measuring device of the conveyed ingredient characterized by coming to constitute as width-of-face edge location detection equipment which detects the location of the width-of-face edge of said conveyed ingredient.
[0020]
[Embodiment of the Invention] First, the edge location detection approach of the conveyed ingredient concerning this invention and its equipment are explained using drawing 1 - drawing 3 . Although drawing 1 - drawing 3 have shown the case where the point of the conveyed ingredient 1 is detected, in this invention, the edge location to detect is not limited at a tip. Moreover, the camera 2 used for this invention is constituted so that it may carry out and the edge of a conveyance ingredient can be detected [which has-dimensional / 1 / or two-dimensional image sensors, and has the proper angle of visibility theta] as usual. Light-receiving wavelength can be suitably set to the element-number list of the photo detector of the image sensors with the detection precision of an edge location. As the light source 3, it shall irradiate the light of the same wavelength as the light-receiving wavelength of image sensors.
[0021] In addition, the conveyed ingredient 1 which is the candidate for detection of this invention is in the condition between heat, and the quality of the material is not limited to steel materials. The edge location

detection equipment concerning this invention is equipped with the camera 2 which has the image sensors arranged above conveyance Rhine of the conveyed ingredient 1, and the light source 3 arranged above conveyance Rhine so that light may be irradiated in the visual field of this camera 2, and as shown in drawing 1 (a), it constitutes it so that an edge location may be detected based on the light-receiving quantity of light of the above-mentioned image sensors.

[0022] And it sets to the edge location detection approach concerning this invention. In case the edge location of the conveyed ingredient 1 is detected, when the light-receiving quantity of light of spontaneous light 1A which receives light with image sensors runs short Light is irradiated from the light source 3 arranged up at the edge, reflected light 3A obtained by reflecting in an edge is added to spontaneous light 1A, the light-receiving quantity of light of reflected light 3A which receives light, and is received and obtained with image sensors is applied to the light-receiving quantity of light of spontaneous light 1A, and the location of an edge is detected.

[0023] For this reason, since the light-receiving quantity of light of image sensors is suppliable, even when edge temperature is low, a highly precise edge location can be detected. The arrow head in drawing shows the conveyance direction. if an example of the detection result of the edge location by this invention is shown -- the light-receiving wavelength of a photo detector -- 0.8 micrometers the image sensors which are one dimension whose light-receiving element number is 1024 pieces -- having -- and a visual field -- a conveyance Rhine top -- 300mm A camera 2 is used. it is -- When the drawing conditions of a camera 2 are doubled with an elevated temperature, the light-receiving time amount of image sensors is set as 1ms and the edge location of the conveyed ingredient 1 with the low temperature of an edge was detected, as shown in drawing 1 (b) In the example of invention which irradiated light from the light source 3, the light-receiving quantity of light of image sensors exceeded the disregard level, and the highly precise edge location was able to be detected.

[0024] On the other hand, when the edge location was detected on the same conditions as the example of invention except it, without irradiating light, only with the spontaneous light from an edge, to the disregard level of image sensors, the light-receiving quantity of light is about 20%, and was not able to detect an edge location. Thus, in this invention, since the light-receiving quantity of light of image sensors can be carried out more than a disregard level, light is not irradiated but ** can also carry out the light-receiving quantity of light more than a disregard level when the temperature of an edge is high even if it is the case that the temperature of an edge is low, even when change of edge temperature is large, an edge location can be detected with a sufficient precision.

[0025] Moreover, in this invention, since a camera 2 and the light source 3 are not arranged down conveyance Rhine, a maintenance can consider as the approach which was with equipment and it with little constraint of an installation easily. In addition, since the light-receiving quantity of light of image sensors is made as for setting up the luminous intensity which measures the temperature of an edge and irradiates it from the light source 3 based on the temperature acquired to the more suitable quantity of light in this invention before arranging a thermometer 4 from the visual field of a camera 2 to the upstream of conveyance Rhine and detecting an edge location as shown in drawing 2 , it is desirable.

[0026] Or like the above, even if it feeds back based on the light-receiving quantity of light which received light with the image sensors of a camera 2 so that the luminous intensity irradiated from the light source 3 may be adjusted after irradiating light from the light source 3, as this invention shows to drawing 3 , since light income in image sensors is made to the suitable light-receiving quantity of light, it is desirable. Furthermore, since using above both together can perform highly precise location detection, it is still more desirable. In addition, when a thermometer 4 cannot be installed, edge temperature is received from a process computer etc., and it can ** so that the luminous intensity irradiated from the light source 3 may be set up.

[0027] In drawing 2 and drawing 3 , 21 and 31 are variable resistors into which the luminous intensity of the light source 3 is changed based on the quantity of light of the temperature of the edge of the conveyed ingredient 1 with a thermometer 4, or the spontaneous light of the edge of the conveyed ingredient 1 which received light with image sensors, respectively. By the way, it arranges instead of camera 2' which showed the edge location detection equipment concerning above-mentioned this invention to drawing 5 (a). The measurements-of-length equipment concerning this invention which it comes to constitute as tip location detection equipment which detects the location of a point Even when change of edge temperature is large, constraint of an installation can consider as little equipment easily [are what can measure the die length of the conveyed ingredient 1 with high precision, and / a maintenance].

[0028] Moreover, it is not necessary to arrange the edge location detection equipment concerning above-

mentioned this invention on both sides across conveyance Rhine, and that the same effectiveness as above measurements-of-length equipment can be demonstrated does not need to explain the width-of-face measuring device concerning this invention which it comes to constitute as width-of-face edge location detection equipment which detects the location of the width-of-face edge of the conveyed ingredient 1. Drawing 4 is the block diagram of an example of the width-of-face measuring device concerning this invention.

[0029] In order to measure width of face with the width-of-face measuring device concerning this invention that what is necessary is just to calculate die-length X by the formula (1) like the data-processing means 15 shown in drawing 5 (a) with the measurements-of-length equipment concerning this invention in order to have measured die length, it is deltaW0+deltaW1+deltaW2 by the data-processing machine 41 every moment at a short period. What is necessary is just to calculate. It sets to drawing 4 and is deltaW0. The criteria width of face between the cameras 2 on either side, deltaW1, and deltaW2 It is the edge location detected with the edge location detection equipment concerning this invention.

[0030]

[Effect of the Invention] According to this invention, in detecting the edge location of the ingredient between heat, constraint of an installation can consider as little equipment easily [a maintenance], and even when change of edge temperature is large, an edge location can be detected with high precision. Consequently, dimensional accuracy, such as die length and width of face, can do advantageous effectiveness so on the industry that a good ingredient can be manufactured.

[Translation done.]

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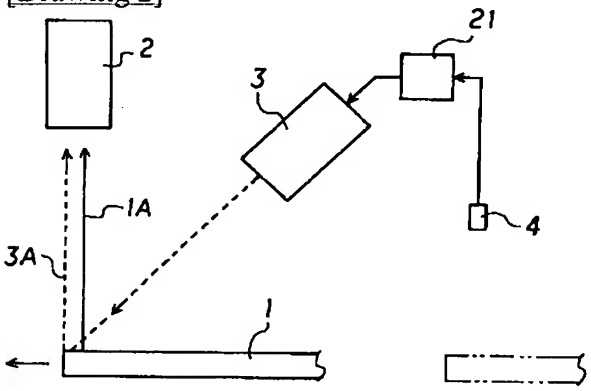
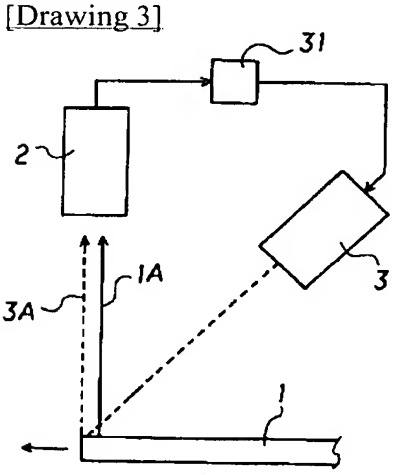
DRAWINGS

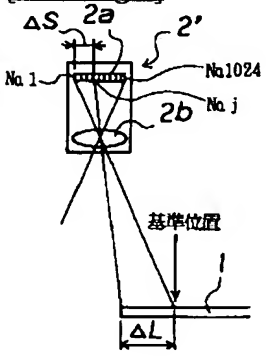
[Drawing 2]



[Drawing 3]

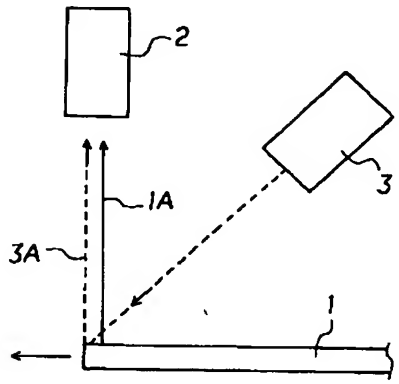


[Drawing 6]



[Drawing 1]

(a)



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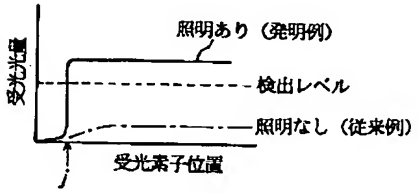

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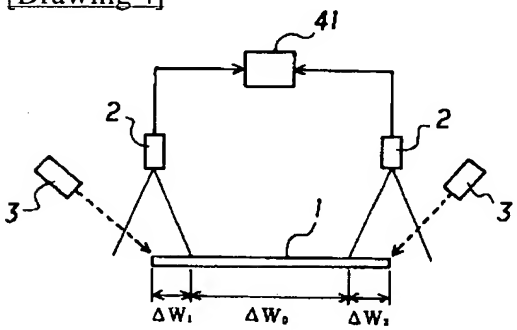
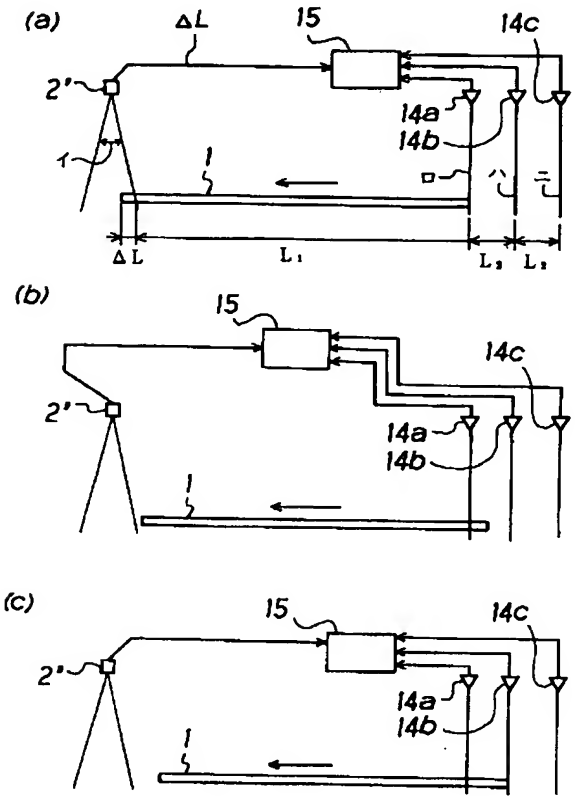
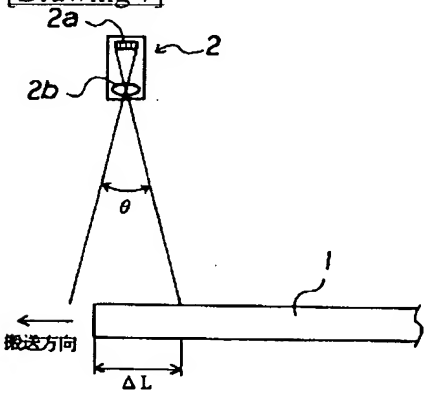


[Drawing 5]

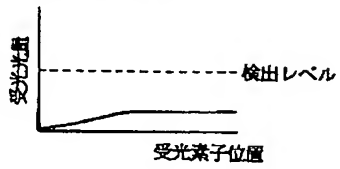


[Drawing 7]

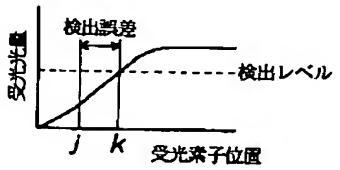


[Drawing 8]

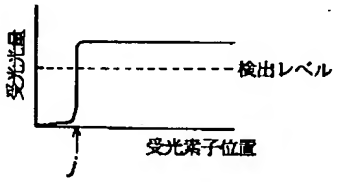
(a) 受光光量が過少の場合



(b) 受光光量が過多の場合



(c) 受光光量が適正な場合



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引用文献 7

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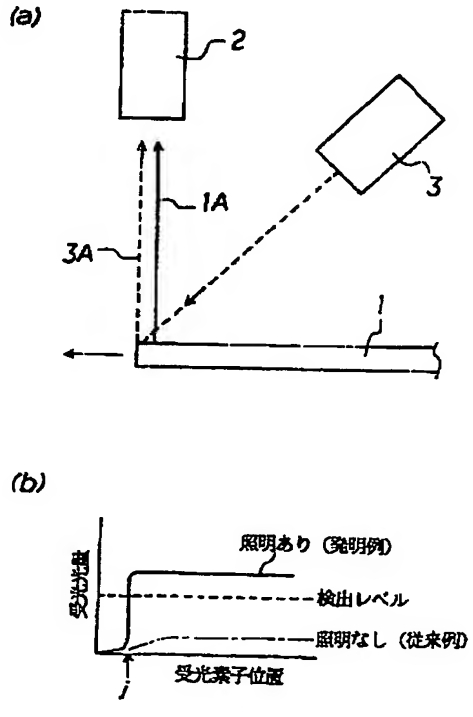
(54)【発明の名称】被搬送材料の端部位置検出方法および装置

(57)【要約】
【課題】　端部温度の変化が大きい場合でも、高精度に端部位置の検出を行うことができると共に、メンテナンスが容易で、かつ設置場所の制約が少ない端部位置検出装置およびその方法を提供する。
【解決手段】　被搬送材料の端部からの自発光を搬送ラインの上方に配置されたカメラのイメージセンサで受光し、受光して得られる自発光の受光光量に基づいて端部の位置を検出する被搬送材料の端部位置検出方法において、イメージセンサで受光する自発光の受光光量が不足する場合に、上方に配置された光源から光を端部に照射し、端部に反射して得られる反射光を自発光に加えてイメージセンサで受光し、受光して得られる反射光の受光光量を自発光の受光光量に加えて端部の位置を検出する。



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【特許請求の範囲】

【請求項１】　被搬送材料の端部からの自発光を搬送ラインの上方に配置されたカメラのイメージセンサで受光し、受光して得られる前記自発光の受光光量に基づいて前記端部の位置を検出する被搬送材料の端部位置検出方法において、前記イメージセンサで受光する自発光の受光光量が不足する場合に、前記搬送ラインの上方に配置された光源から光を前記端部に照射し、前記端部に反射して得られる反射光を前記自発光に加えて前記イメージセンサで受光し、受光して得られる前記反射光の受光光量を前記自発光の受光光量に加えて前記端部の位置を検出することを特徴とする被搬送材料の端部位置検出方法。

【請求項２】　前記端部の位置を検出する前に、前記端部の温度を測定し、得られる温度に基づいて前記光源から照射する光の強度を設定することを特徴とする請求項１に記載の被搬送材料の端部位置検出方法。

【請求項３】　前記端部に上方の光源から光を照射し、受光して得られる前記反射光の受光光量と前記自発光の受光光量との和に基づいて前記光源から照射する光の強度を調整することを特徴とする請求項１または２に記載の被搬送材料の端部位置検出方法。

【請求項４】　請求項１～３のいずれかに記載の被搬送材料の端部位置検出方法を用いて検出された前記端部の位置に基づいて、前記被搬送材料の長さ、あるいは前記被搬送材料の幅を測定することを特徴とする被搬送材料の寸法測定方法。

【請求項５】　搬送ラインの上方に配置されたイメージセンサを有するカメラと、該カメラの視野内に光を照射できるように、前記搬送ラインの上方に配置された光源とを備え、前記イメージセンサの受光光量に基づいて被搬送材料の端部位置を検出するように構成してなることを特徴とする被搬送材料の端部位置検出装置。

【請求項６】　請求項５に記載の被搬送材料の端部位置検出装置を後端部位置検出装置より搬送ラインの下流側に配置し、前記被搬送材料の先端部の位置を検出する先端部位置検出装置として構成してなることを特徴とする被搬送材料の長さ測定装置。

【請求項７】　請求項５に記載の被搬送材料の端部位置検出装置を搬送ラインを挟んで両側に配置し、前記被搬送材料の幅端部の位置を検出する幅端部位置検出装置として構成してなることを特徴とする被搬送材料の幅測定装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、被搬送材料、特に、搬送される熱間材料の端部位置を検出するのに好適な被搬送材料の端部位置検出方法並びにその装置、およびそれを用いた測定方法並びに測定装置に関する。

【０００２】

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【従来の技術】帯板や管等の材料を搬送しつつ、寸法を精度良く測定することは、その材料を製造するうえで重要であり、例えば、搬送される熱延帯板は幅や長さを測定して圧延を行って製造されている。被搬送材料の幅や長さを測定する方法として、搬送テーブルの上方にＣＣＤカメラ（以下、イメージセンサを有するカメラ、または単にカメラという）を設け、カメラと対向する搬送テーブルの下方に光源を設けて、熱間材料の位置検出を行うことが知られている。

【０００３】しかし、このようにして熱間材料の位置検出を行う場合、搬送テーブルの下方に設けた光源は、レンズが熱間材料から飛散したスケール等により汚れやすいために、メンテナンスを高頻度で行わなければならず、メンテナンス作業が大変であるという欠点があり、また、装置を設置しようとした場合、例えば、付帯装置の多い圧延機の近くでは下方の光源の光が搬送テーブルに遮光されるなどの制約により、設置できない場合がある。

【０００４】このような問題点を解消する方法として、被搬送材料からの自発光をイメージセンサで受光し、被搬送材料の端部位置を検出する方法が広く知られている。たとえば、特開昭55-12478号公報には、図５に示す長さ測定装置に上記の方法を適用していることが示されている。図５において、１は被搬送材料であり、図中矢印で示す方向に搬送されるようになっており、２'は所定の視野角イを有するカメラであり、14a 、14b 、14c はそれぞれスポット状の微小視野ロ、ハ、ニを有する光電スイッチである。

【０００５】ここで、カメラ２'は先端部位置を検出するように構成された端部位置検出装置であって、カメラ２'は、図６に示すように１次元のイメージセンサ2aと結像系2bを有する。一方、この長さ測定装置では、光電スイッチ14a 、14b 、14c は、複数対の投光器および受光器で構成され、被搬送材料１が視野にない状態と視野にある状態の差を光学的に検出して、被搬送材料１の後端位置を検出する後端位置検出装置を構成している。そして、光電スイッチ14a 、14b 、14c およびカメラ２'の信号は演算処理手段15に入力されている。

【０００６】この装置における長さの測定原理について説明すると、この長さ測定装置では、被搬送材料１が搬送されていき、後端が後端位置検出装置のいずれかの光電スイッチ14a 、14b 、14c で検出されたときに、先端がカメラ２'の視野内に入っている状態において被搬送材料１の長さを測定するようになっている。すなわち、図５（ｃ）の状態では光電スイッチが14b が被搬送材料１の後端位置を検出した瞬間であるが、先端がカメラ２'の視野内に入っていないので被搬送材料１の長さは測定できず、図５（ｂ）の状態でも先端がカメラ２'の視野内に入っていないので同様に測定できないが、図５（ａ）の状態となって初めて、光電スイッチ14a が後端

を検出した瞬間に先端がカメラ２’の視野内に入り、被搬送材料１の長さが測定できる状態となっている。

【０００７】この状態において、被搬送材料１の長さＸは式（１）で表される。

$$X = L_1 + \Delta L + n \cdot L_2 \quad \cdots\cdots\cdots (1)$$

なお、L_1は光電スイッチ14aからカメラ２’の基準位置（始点）までの距離、L_2は光電スイッチ間の距離であり、ｎはどの光電センサーが対象材料１の後端位置を検出したか（図５では光電スイッチ14a）を示し、14a、14b、14cの場合それぞれ０、１、２となる。

【０００８】また、ΔＬは、カメラ２’の基準位置から被搬送材料１の先端までの距離であり、先端位置検出装置として構成されたカメラ２’により検出する。先端位置検出装置であるカメラ２’においては、図６に示すように、被搬送材料１の端部からの自発光を受光しているイメージセンサの長さΔＳ（受光素子No.1～No. J）が被搬送材料１の端部長さΔＬと対応するように構成されている。

【０００９】そこで、先端位置検出装置であるカメラ２’では、端部からの自発光の受光光量が検出レベル以上となっている受光素子の数Ｊを検出することによって、数Ｊを被搬送材料１の端部位置検出値とし、式（２）によりΔＬを求め、被搬送材料１の端部位置を検出する。なお、ΔＬは被搬送材料１の端部長さでもある。

$$\Delta L = 300 / 1024 \cdot j \quad \cdots\cdots\cdots (2)$$

但し、イメージセンサ2aの受光素子数は1024個とし、カメラ２’の視野は300mm とした。

【００１０】この長さ測定装置では、検出された被搬送材料１の端部位置ΔＬが演算処理手段15に送られて、演算処理手段15で式（１）によりＸを演算するように構成されているので、被搬送材料１の長さＸが測定できるのである。

【００１１】

【発明が解決しようとする課題】しかしながら、上記と同様に端部位置を検出できるように構成したイメージセンサを有するカメラを用い、鋼板を熱間圧延するラインにおいて測定された幅や長さが実測値と異なる場合があるという問題点があった。そこで、本発明者らは、上記の原因を究明するために、イメージセンサを有するカメラ２を上記と同様に端部位置を検出できるように構成し、鋼板の先端部からの自発光を図７に示すようにしてイメージセンサ2aで受光し、イメージセンサ2aの受光素子位置と端部からの受光光量との関係を調査した。その結果、測定された長さが実測値と異なる原因は、材料によって端部の温度が大きく変わるために、端部からの自発光強度が大きく変化し、端部の温度が低いときには、カメラ２の視野内に端部入っているにもかかわらず、全ての受光素子の受光光量が検出レベル未満となって、位置検出が行えていない場合があることが判明した。

【００１２】なお、図７に示すカメラ２は、受光素子の受光波長が0.8 μm で、受光素子数が1024個の１次元イメージセンサを有し、かつ視野が搬送ライン上で300mm であるものを使用した。上記結果の一例を説明すると、端部位置を検出できるように構成しカメラ２の絞り条件を高温に合わせ、イメージセンサの受光時間を１msに設定してあった場合に、例えば、端部の温度が低くて、自発光強度が1/1000になるようなときには、図８（ａ）に示すように、カメラ２の視野内に端部が入っているにもかかわらず、全ての受光素子の受光量が検出レベル未満となって、端部位置の検出が行えていないのである。

【００１３】ところで、これを回避するために、絞り条件を高温に合わせた状態で、端部の温度が低いときに、例えば、イメージセンサの受光時間を１秒と長時間に設定したのでは、検出間隔が長くなって、その間での材料移動量が大きく、高精度な位置検出が行えないだけでなく、端部の検出が行えない場合も発生するので、このような方法は採用することができない。

【００１４】また、上記の検出条件とは反対に、カメラ２の絞り条件を低温に合わせ、イメージセンサの受光時間を１msに設定した場合には、端部温度が高いときに受光素子の受光光量が過多となってしまい、図８（ｂ）に示すように、受光素子の受光光量が適正な場合（図８（ｃ）参照）の位置検出値ｊと異なってしまい、高精度な端部位置の検出が行えないので、この方法も採用することができない。

【００１５】そこで、本発明の目的は、上記従来技術の被搬送材料の端部位置検出方法における問題点を解消することにあり、端部温度の変化が大きい場合でも、高精度に端部位置の検出を行うことができると共に、メンテナンスが容易で、かつ設置場所の制約が少ない端部位置検出装置およびその方法を提供することにある。

【００１６】

【課題を解決するための手段】本発明は、被搬送材料の端部からの自発光を搬送ラインの上方に配置されたカメラのイメージセンサで受光し、受光して得られる前記自発光の受光光量に基づいて前記端部の位置を検出する被搬送材料の端部位置検出方法において、前記イメージセンサで受光する自発光の受光光量が不足する場合に、前記搬送ラインの上方に配置された光源から光を前記端部に照射し、前記端部に反射して得られる反射光を前記自発光に加えて前記イメージセンサで受光し、受光して得られる前記反射光の受光光量を前記自発光の受光光量に加えて前記端部の位置を検出することを特徴とする被搬送材料の端部位置検出方法である。

【００１７】このように構成することにより、端部温度が低い場合でも、高精度な位置検出を行うことができるようになり、上記課題を解決できる。また、本発明は、上記において、前記端部の位置を検出する前に、前記端部の温度を測定し、得られる温度に基づいて前記光源か

ら照射する光の強度を設定するか、もしくは、前記端部に上方の光源から光を照射し、受光して得られる前記反射光の受光光量と前記自発光の受光光量との和に基づいて前記光源から照射する光の強度を調整することが、より高精度な位置検出を行うことができるので好ましく、さらに、両者を併用するようにするのが、一段と高精度な位置検出を行うことができるので好ましい。

【００１８】さらにまた、本発明は、上記のいずれかに記載の被搬送材料の端部位置検出方法を用いて検出された前記端部の位置に基づいて、前記被搬送材料の長さ、あるいは前記被搬送材料の幅を測定することを特徴とする被搬送材料の寸法測定方法とすることもできる。上記方法に用いる本発明は、搬送ラインの上方に配置されたイメージセンサを有するカメラと、該カメラの視野内に光を照射できるように、前記搬送ラインの上方に配置された光源とを備え、前記イメージセンサの受光光量に基づいて被搬送材料の端部位置を検出するように構成してなることを特徴とする被搬送材料の端部位置検出装置である。

【００１９】また、本発明は、上記の被搬送材料の端部位置検出装置を後端部位置検出装置より搬送ラインの下流側に配置し、前記被搬送材料の先端部の位置を検出する先端部位置検出装置として構成してなることを特徴とする被搬送材料の長さ測定装置とすることもできる。あるいは、本発明は、上記の被搬送材料の端部位置検出装置を搬送ラインを挟んで両側に配置し、前記被搬送材料の幅端部の位置を検出する幅端部位置検出装置として構成してなることを特徴とする被搬送材料の幅測定装置とすることもできる。

【００２０】

【発明の実施の形態】まず、図１～図３を用いて、本発明に係る被搬送材料の端部位置検出方法およびその装置について説明する。図１～図３では、被搬送材料１の先端部を検出する場合について示してあるが、本発明では、検出する端部位置は先端に限定されない。また、本発明に用いるカメラ２は１次元または２次元のイメージセンサを有し、かつ適宜な視野角θを有するするもので、従来と同様に搬送材料の端部を検出できるように構成されている。そのイメージセンサの受光素子の素子数並びに受光波長は端部位置の検出精度によって適宜定めることができる。光源３としては、イメージセンサーの受光波長と同じ波長の光を照射できるものとされている。

【００２１】なお、本発明の検出対象である被搬送材料１は熱間状態にあり、その材質は鋼材に限定されない。本発明に係る端部位置検出装置は、図１（ａ）に示すように、被搬送材料１の搬送ラインの上方に配置されたイメージセンサを有するカメラ２と、このカメラ２の視野内に光を照射できるように、搬送ラインの上方に配置された光源３とを備え、上記のイメージセンサの受光光量に基づいて端部位置を検出するように構成してある。

【００２２】そして、本発明に係る端部位置検出方法においては、被搬送材料１の端部位置を検出する際に、イメージセンサで受光する自発光1Aの受光光量が不足する場合に、端部に上方に配置された光源３から光を照射し、端部に反射して得られる反射光3Aを自発光1Aに加えてイメージセンサで受光し、受光して得られる反射光3Aの受光光量を自発光1Aの受光光量に加えて端部の位置を検出する。

【００２３】このために、イメージセンサの受光光量を補うことができるので、端部温度が低い場合でも高精度な端部位置の検出を行うことができる。図中の矢印は、搬送方向を示している。本発明による端部位置の検出結果の一例を示すと、受光素子の受光波長が0.8μmで、受光素子数が1024個の１次元のイメージセンサを有し、かつ視野が搬送ライン上で300mmであるカメラ２を使用し、カメラ２の絞り条件を高温に合わせ、イメージセンサの受光時間を１msに設定しておいて、端部の温度の低い被搬送材料１の端部位置を検出したところ、図１（ｂ）に示すように、光源３から光を照射した発明例では、イメージセンサーの受光光量が検出レベルを上回り、高精度な端部位置の検出が行えた。

【００２４】これに対して、光を照射せずに、それ以外は発明例と同じ条件で端部位置を検出したところ、端部からの自発光のみでは、受光光量がイメージセンサーの検出レベルに対して20％程度であり、端部位置を検出できなかった。このように、本発明では、端部の温度が低い場合であってもイメージセンサーの受光光量を検出レベル以上にすることができ、端部の温度が高い場合には光を照射せずとも受光光量を検出レベル以上にすることができるから、端部温度の変化が大きい場合でも、端部位置を精度良く検出できる。

【００２５】また、本発明では、カメラ２および光源３を搬送ラインの下方に配置していないので、メンテナンスが容易で、かつ設置場所の制約が少ない装置とそれをもちいた方法とすることができる。なお、本発明では、図２に示すように、温度計４をカメラ２の視野より搬送ラインの上流側に配置して、端部位置を検出する前に端部の温度を測定し、得られる温度に基づいて光源３から照射する光の強度を設定することがイメージセンサーの受光光量をより適切な光量にできるので好ましい。

【００２６】あるいは、本発明では、図３に示すように、光源３から光を照射した後、カメラ２のイメージセンサーで受光した受光光量に基づいて、光源３から照射する光の強度を調整するように、フィードバックしても、上記と同様に、イメージセンサーにおける受光量を適切な受光光量にできるので好ましい。さらには、上記の両者を併用するようにするのが、一段と高精度な位置検出を行うことができるのでさらに好ましい。なお、温度計４を設置できないような場合には、プロセスコンピ

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ューター等より端部温度を受信し、光源３から照射する光の強度を設定するようもできる。

【００２７】図２、図３において、21、31は、温度計４による被搬送材料１の端部の温度、あるいはイメージセンサーで受光した被搬送材料１の端部の自発光の光量に基づいてそれぞれ光源３の光の強度を変える可変抵抗器である。ところで、上記の本発明に係る端部位置検出装置を図５（ａ）に示したカメラ２'の代わりに配置し、先端部の位置を検出する先端位置検出装置として構成してなる本発明に係る長さ測定装置は、端部温度の変化が大きい場合でも、被搬送材料１の長さを高精度に測定できるものであり、かつメンテナンスが容易で、かつ設置場所の制約が少ない装置とすることができる。

【００２８】また、上記の本発明に係る端部位置検出装置を搬送ラインを挟んで両側に配置し、被搬送材料１の幅端部の位置を検出する幅端部位置検出装置として構成してなる本発明に係る幅測定装置は、上記の長さ測定装置と同様な効果が発揮できることは説明するまでもない。図４は、本発明に係る幅測定装置の一例の構成図である。

【００２９】本発明に係る長さ測定装置により、長さを測定するには、図５（ａ）に示した演算処理手段15と同様に式（１）により長さＸを演算するようにすればよく、また、本発明に係る幅測定装置により、幅を測定するには、短周期で刻々と演算処理器41により$\Delta W_0 + \Delta W_1 + \Delta W_2$を演算すればよい。図４において、$\Delta W_0$は左右のカメラ２間の基準幅、$\Delta W_1$、$\Delta W_2$は、本発明に係る端部位置検出装置により検出した端部位置である。

【００３０】

【発明の効果】本発明によれば、熱間材料の端部位置を検出するに当たり、メンテナンスが容易で、かつ設置場所の制約が少ない装置とすることができ、かつ端部温度の変化が大きい場合でも、高精度に端部位置を検出することができる。その結果、長さや幅等の寸法精度が良好な材料を製造できるという産業上有利な効果を奏することができる。

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【図面の簡単な説明】

【図１】（ａ）は本発明に係る端部位置検出装置の構成図、（ｂ）は本発明による検出結果を従来例と比較したグラフである。

【図２】本発明に用いる好ましい端部位置検出装置の構成図である。

【図３】本発明に用いる他の好ましい端部位置検出装置の構成図である。

【図４】本発明に係る幅測定装置の構成図である。

【図５】従来の長さ測定装置の構成図である。

【図６】イメージセンサを有するカメラの説明図である。

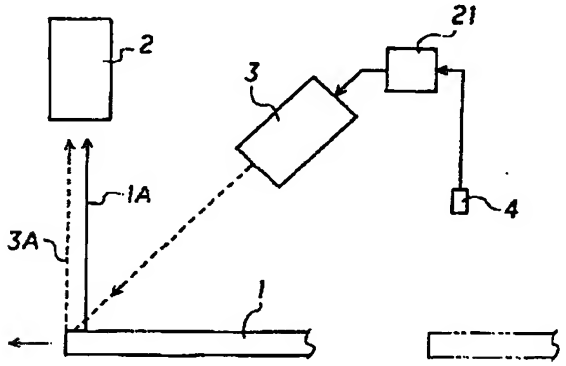
【図７】本発明に用いたイメージセンサを有するカメラの一例の配置図である。

【図８】図７に示したカメラによる端部位置検出結果の一例のグラフである。

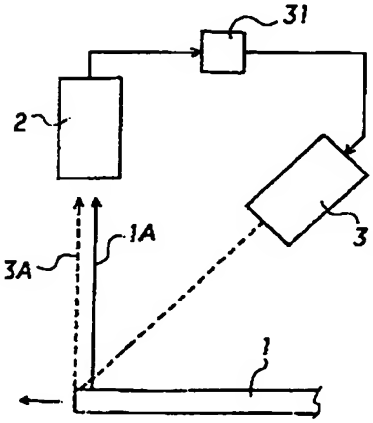
【符号の説明】

１　被搬送材料（熱間材料）
２、２'　カメラ
2a　イメージセンサ
2b　結像系（レンズ）
３　光源
1A　自発光
3A　反射光
４　温度計
14a、14b、14c　光電スイッチ
15　演算処理手段
21、31　可変抵抗器
41　演算処理器
ΔＬ、ΔＷ　端部の位置

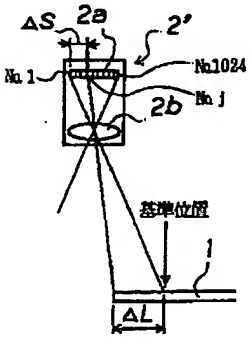
【図２】



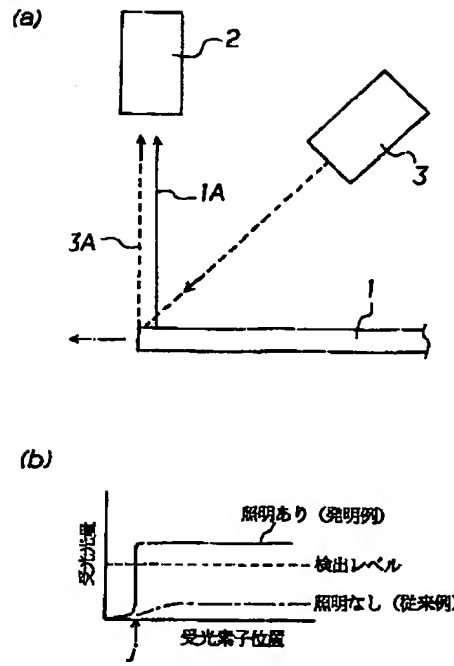
【図３】



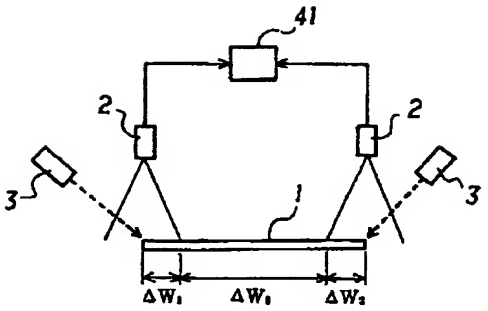
【図６】



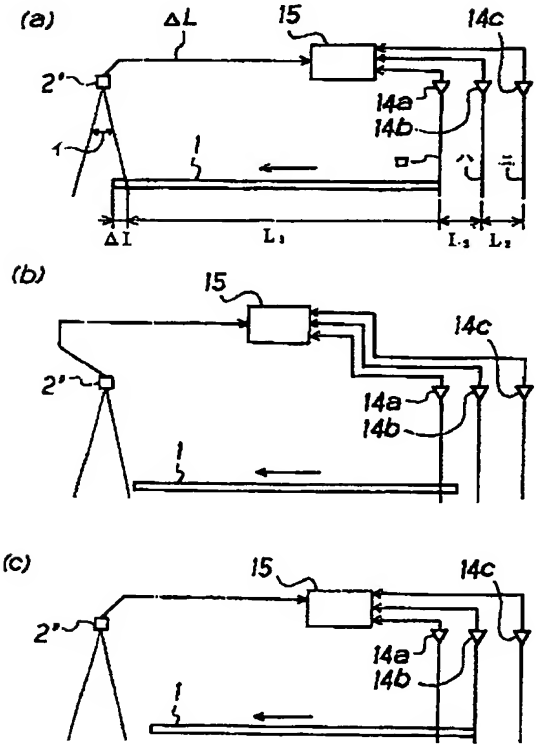
【図１】


(a)
2
1A
3
3A
1
(b)
照明あり（発明例）
検出レベル
照明なし（従来例）
受光光量
受光素子位置

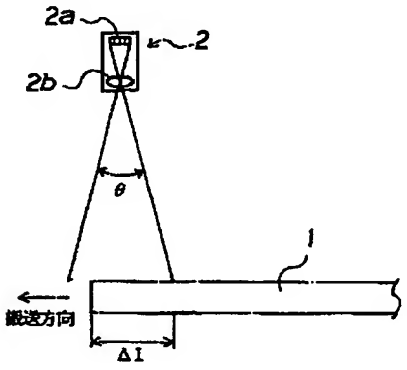
【図４】


41
2
2
3
3
1
ΔW₁
ΔW₀
ΔW₂

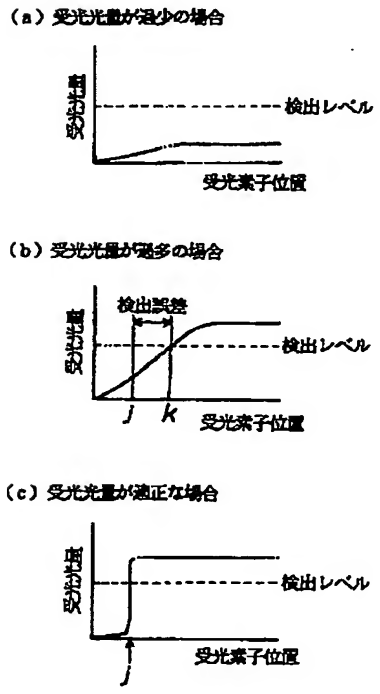
【図５】


(a)
ΔL
15
14c
2'
14a
14b
1
ΔI
L₁
L₂
(b)
15
14c
2'
14a
14b
1
(c)
15
14c
2'
14a
14b
1

【図７】


2a
2
2b
θ
1
搬送方向
ΔI

【図８】


（a）受光光量が過少の場合
受光光量
検出レベル
受光素子位置
（b）受光光量が過多の場合
検出誤差
受光光量
検出レベル
j
k
受光素子位置
（c）受光光量が適正な場合
受光光量
検出レベル
受光素子位置

フロントページの続き

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